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RenoseeC: renovating with a social, ecological and economic benefit through a collective approach

Heuts E[a], Versele A[a,1]

[a] *KU Leuven, Gebroeders De Smetstraat 1, 9000 Gent, Belgium*

Abstract

RenoseeC is one of ten Flemish VLAIO subsidised Living Labs on dwelling renovations. On the basis of a catalogue of technical, financial and legal solutions there will be a collective renovation of twenty houses, with the aim of affordably improving the quality of life for homeowners/residents and the energy performance of their buildings. The RenoseeC project has the aim to renovate houses for different target groups in socially deprived neighbourhoods, with the focus on low-income families and tenants. After renovation, the aim is to draw up a business model and to upscale the project to other neighbourhoods or cities.

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Keywords: collective renovation, deprived neighbourhoods, low income families, energy saving

1. Introduction

According to EU-SILC 2014 15.5% of Flemish families live at risk of poverty and social exclusion [24]. This figure is based on three indicators: relative poverty, very low work intensity and severe material deprivation. Although Flemish housing policy starts from the constitutional right to decent housing and assigns priority to the housing needs of low-income households, research shows that the goals of housing policy are far from met.

* Corresponding author. Tel.: +32 9 265 86 12
E-mail address: eva.heuts@kuleuven.be

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Buildings are responsible for 40% of energy consumption and 36% of CO_2 emissions in the EU [16]. Furthermore, a study of McKinsey [8] shows that the energy performance of the Belgian housing stock is 72% higher than the European average (average annual primary energy use is 348 kWh/(m².a) compared to 203 kWh/(m².a)). In order to tackle the lack of energy performance, the Flemish government started the 'Renovation pact'. The purpose of this pact is to elaborate a model with short-, middle- and long-term perspectives on how to improve the renovation rate of the Flemish housing stock and to optimise the energy performance of these buildings to nearly zero-energy level. To achieve these objectives, amongst others, ten Flemish VLAIO Living Labs on dwelling renovations were put into operation, of which one is the RenoseeC project.

The RenoseeC project has the aim to renovate houses for different target groups in socially deprived neighbourhoods with the focus on low-income families and tenants. The project focuses on this group of people in particular, as, for them, it is becoming more and more difficult to find an affordable house of good quality. Research from the Energy Renovation Program 2020 from the Flemish government [11] shows that lower income families represent more than 30% of the surveyed residents without roof insulation. The same results were found in [9, 10]: the presence of insulation and double-glazing scores significantly lower in the quintiles with lower incomes. Additionally, a large-scale survey regarding living conditions in 2013 [12] showed that the proportion of households with a housing cost above 30% rose from 12.7 to almost 20% between 2005 and 2013. Furthermore, nearly 1 out of 5 Belgian households live in a state of energy poverty [19].

Moreover, in Flanders only 6% of the total building stock consists of social housing estates. Although Ghent - with about 12% - scores remarkably better than the Flanders average, compared to Holland and France (30% and 65%, respectively) [18], the number of social housing estates is still too small. In addition, the rental market is under pressure. A study conducted by KU Leuven [12] and based on an extensive survey results shows that a big majority of landlords are over 65. These landlords opt to sell rather then to renovate their properties, leading to a shrinking rental market. Add to this the significant rise of property prices over the last years in central Flemish cities such as Ghent [17], and the most vulnerable families are forced to live in dwellings on the private (rental) market, often in socially deprived neighbourhoods (such as in the 19th century belt around Ghent) where most houses do not meet currents requirements on comfort and energy performance [1].

Within the RenoseeC pilot project, there will be a collective renovation of at least twenty houses, aiming to improve the quality of living for homeowners/residents and the energy performance of their buildings in an ecologically responsible and affordable way. Finally, the consortium is also in the process of drawing up a business model in order to upscale the project to other neighbourhoods or cities. The pilot project addresses five specific research questions and challenges: (i) the optimisation of the collective approach, (ii) the cooperation of the supply side, (iii) the strengthening of the demand side, (iv) the reach of vulnerable groups and (v) the scalability and reproducibility.

The overall purpose of this paper is to evaluate these questions in the middle of the pilot project, 1.5 years after the launch of it. What can be learned? What do we have to evaluate and incorporate in the business model?

1. Methodology

Through an extensive information and selection process potential participants with renovation needs were identified. After thorough screening of both their homes as well as their personal situation, a detailed renovation plan was elaborated. Based on this, potential participants received an individual proposition for enrolling in the actual renovation project. For the concerned houses all necessary renovation needs are specified and bundled in an overall tender, which is launched for interested contractors. After renovation, the aim is to draw up a business model and to upscale the project to other neighbourhoods or cities.

1.1. *Selection of districts and recruitment of participants*

RenoseeC wants to improve the community aspect of social cohesion, and in order to make an efficient collective renovation possible, the partners decided to focus on a few specific areas. Based on the available data on social (e.g. income, employment, origin, family composition) and building indicators (density, living area, building year and comfort, energy performance) from the city of Ghent [1], the different stakeholders selected two sectors, namely Sint-Amandsberg center and Dampoort center.

In these two areas an information campaign was launched, explaining the guidelines of the project. A useful tool in provoking interest and gaining people's trust proved to be a free housing scan. After they signed up for this, one of the RenoseeC partners would visit them at home, doing a basic screening of both their home as well as their socio-economic situation, whilst explaining the project in detail. Afterwards they also received a free report, listing technical shortcoming of their homes and standardised advice. Through several information meetings, interested candidates were updated on the details of the whole process and given a chance to enrol in the project. A part of the scan was in collaboration with the European project EPISCOPE [4]. This survey assesses the condition of the house and the energy behaviour of the residents. On the base of a model that residents' behaviour brings into account, the potential energy-savings from renovation were searched. The overall strategic objective of the EPISCOPE project is to make the energy refurbishment processes in the European housing sector transparent and effective. This will help to ensure that the climate protection targets will actually be attained and that corrective or enhancement actions can be taken in due time, if necessary.

1.2. *Analysing renovation needs*

In total, about forty homeowners enrolled in the next phase of the project. Based on the results of the housings scans, an in-depth analysis was performed for every house individually. This resulted in a customised renovation plan, which was carefully elaborated in consultation with homeowners. After bundling all renovation measures, a tender was launched for interested contractors.

1.3. *Monitoring case studies*

Based on the ambitious climate plans of the city of Ghent, RenoseeC sets the goal for primary energy consumption after renovation to a maximum of 70 kWh/(m².a) for heating [2].

Monitoring before and after renovation aims to understand the comfort and energy performance of the building and the applied renovation modules. Actual consumption data is also necessary in order to compare the developed renovation modules and other standard solutions offered, to review and make adjustments.

A University (KU Leuven) is monitoring the indoor climate (temperature, relative humidity) and energy performance (infra-red scans, airtightness test) and use (by accounts, an energy logger) of twelve dwellings with varying characteristics: most of them are terraced single-family houses, one is a detached house, all with a surface between 120 m² and 220 m². Most of the dwellings are heated with gas; one with electricity. The heating source of two-thirds of the dwellings is central heating on gas, by one-third it is a gas stove. The compactness also varies between compact dwellings (2) and less compact dwellings (1,45).

To determine the most cost-optimal renovation scenarios, the 'CashFlowSimulator' was used which is developed by Renofase [21] and aims to give customers substantiated advice by weighing costs and expected energy savings. For four houses different scenarios (components of the catalogue of technical solutions), were calculated to find the most cost optimal choice for every component. The CashFlowSimulator is developed in order to make a consideration between cost and energy savings, and to give customers substantiated advice.

1.4. *Catalogue of technical solutions*

In order to guarantee efficient and cost-optimal renovations, RenoseeC developed a catalogue of technical solutions containing various refurbishment possibilities for pitched roofs, flat roofs and walls, with both insulation on the inside as well as the outside. Every building component includes the application of mineral, petrochemical or bio-based materials and is taking into account varying effective thermal insulation values: roofs have a U-value of 0.11 W/m²K or 0.18 W/m²K, walls have a U-value of 0.20 W/m²K or 0.28 W/m²K.

The most frequently used construction methods of the neighbourhood are the base of the components in the catalogue. For example, most houses have a brick wall of 20 cm and an uninsulated roof with purlins and rafters.

For the 40-some components, an info sheet is included which contains a drawing, the description of the used materials, preconditions, insulation and environmental performance (Life Cycle Analysis). Buildings have a huge impact on the environment. Today's focus is – justifiably – on energy-efficient construction methods. However, much of the impact can be attributed to the materials used in buildings, as these have an environmental effect during production and transport, during the construction of the building and also during demolition [5]. Therefore, a Life Cycle Analysis is conducted for every building component of the catalogue to understand the environmental profile (impact) of variations in materials and building components included in the catalogue of technical solutions The transparent methodological framework of Environmental Performance of Materials used in Building Elements (MMG) set up by OVAM was used [5]. All these indicators have a different unit (kg, MJ, sqm) and therefore these values are monetised: they are reduced to a single score expressed in environmental costs (euro). This is the cost society is carrying to avoid or undo the environmental effects caused by energy consumption and materials.

1.5. Catalogue of financial solutions

In order to guarantee efficient and cost-optimal renovations, RenoseeC founded a group of financial experts to discuss alternative financial solutions and aims to develop a catalogue of financial solutions. Focusing on low-income families in particular, alternative financial solutions are investigated such as grant retention and Community Land Trust principles. After all, the conventional financial and instrumental incentives are not sufficient to encourage low-income families to start an energetic renovation of their dwelling [3]. The Flemish Energy Loan for example is a very interesting loan for all kinds of energy saving measurement (maximum €10.000), with very interesting advantages: e.g. certain groups can get an interest-free loan (0% interest), but there are some bottlenecks. The loan amount must be repaid in five years, which is very difficult or even impossible for low-income families. Besides, people whose homes need renovation the most don't even know that this loan exists.

As renovation of housing is an important part of the local climate plans, collective renovation projects like RenoseeC can or have to be an important part of the financing of local climate plans. Commissioned by the cities of Ghent and Antwerp Technum/SUMA Consulting worked out the financial aspect at their local climate plans.[23]

1.6. *Catalogue of legal solutions*

A mandate agreement will be signed by each participant. The client gives the mandate to the architect to sign contracts with the contractors and to make payments. To make this possible an escrow account is opened by a bank. The client deposits the sum in predetermined amounts on the escrow account.

To select suitable contractors for the renovation, a procedure consisting of two phases was set up. In a first stage, four candidates are selected based on of references, timing, local and social economy, etc. Based on a number of award criteria (price, detailed planning and timing) a contractor will be chosen from the first selection.

1.7. *Social impact assessment*

To understand and upscale the project in a later phase, the social impact must be assessed. Under the guidance of 'The Social Innovation Factory' [22] the input, output, outcome and impact of RenoseeC is determined. By making clear who and what is being evaluated, the right evaluation questions, indicators, etc. could be determined.

The aim is to evaluate the following aspects: number of energetic renovations, energy performance and CO_2 emissions, number of low-income families involved, housing costs and affordability, social cohesion, quality of living and residential satisfaction, etc.

By measuring the social impact, stakeholders may be convinced to participate in the project. As a function of the (social) impact on society, partners in general and financial institutions in particular, will be interested to invest in this project. Besides, other cities might be interested to launch the RenoseeC-project in one of their neighbourhoods.

2. Results

Only limited publicity (flyers, posters) was necessary to announce the project to the middle class in the area, but to reach and convince the vulnerable target audience was more difficult and took more time and energy. About 110 households were contacted, of which 76 households effectively joined the first phase of the project. For each of these 76 participants, a free housing scan was performed, revealing moisture problems in 47% and safety risks related to CO intoxication in 24% of the investigated cases. In 8% of the cases, even basic comfort like hot water is lacking. 21% of the houses have single pane windows. 82% lack wall insulation while 42% has no roof insulation. 18% of the houses do not have central heating but uses gas stoves. The housing scan was more than visiting the houses and giving advice about energy saving solutions: it also gave us the opportunity to get to know the people of the neighbourhood. A lot of people have talents, interests, capacities to offer; by bringing them together and by giving them a chance to meet each other, hopefully more social cohesion can be realised. Pro-active, personal contact and direct communication is necessary to fully involve the target group.

The (voluntary) next step in the project consists of the execution of a more in-depth analysis of the houses. In total 40 extensive scans have been performed including, amongst other measurements, subsidy calculation, detailed bill of quantities, the design drawings, etc. Most of the participating households (50%) have small renovation plans, e.g. insulation of the roof… (estimated €20.000), 25% of them are planning a deep renovation (estimated €50.000), 25% are planning an extension (estimated €60.000). At the moment of writing, twenty renovations will be performed with an average cost of €40.000.

2.1. *Monitoring results of the case studies*

In the next subsections, you can find the provisional conclusions from the indoor climate monitoring, infra-red scans, energy use and scenario analysis.

2.1.1. Comfort / indoor climate monitoring

The comfort level varies widely from house to house: some bedrooms are not heated and have a temperature of only 11°, others have a temperature of almost 18°. The temperature of the living room varies much stronger in an uninsulated house: the house cools down much faster (Figure 1). Temperature fluctuation is not only dependent on the building envelope, but also on the use of the heating. However, the non-insulated house has a lower average temperature than the better-insulated house.

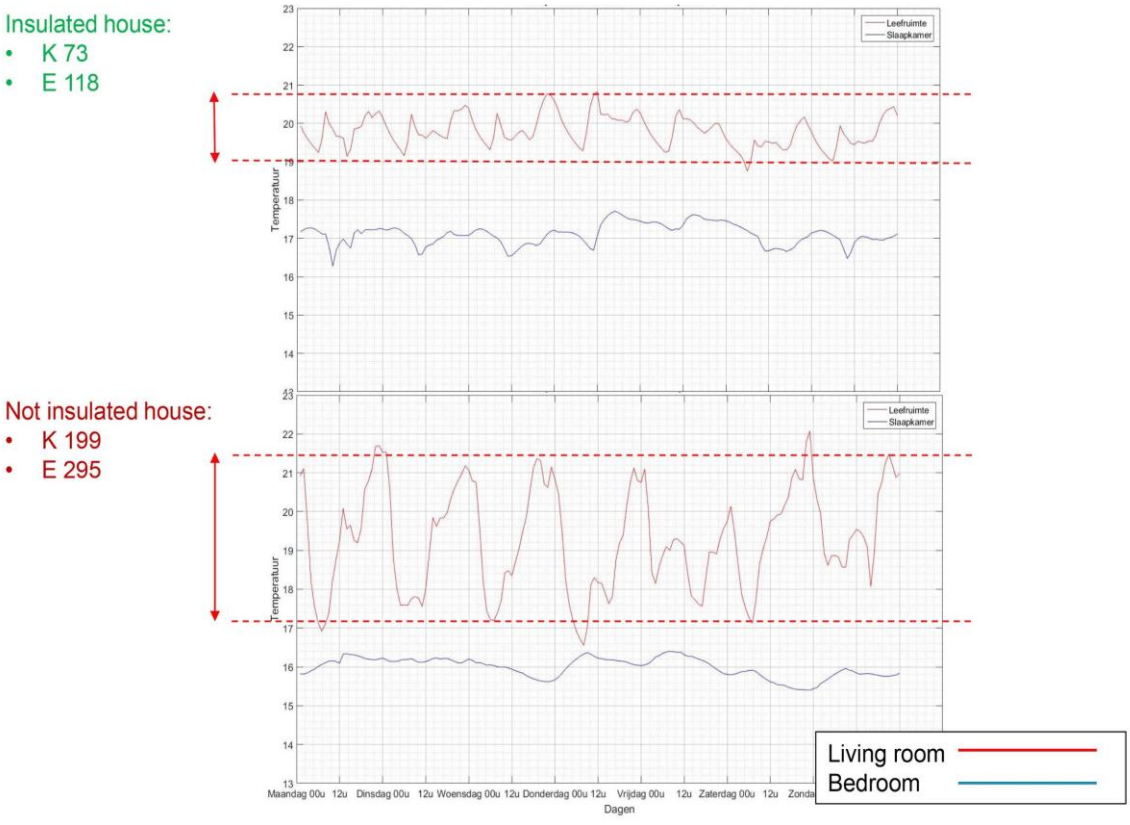

Figure 1: Week proceedings of the temperature in the living room and bedroom, for two houses.

Relative humidity in uninsulated houses is a higher than in insulated houses. The relative humidity of the living room varies much stronger in an uninsulated house: associated with the fluctuation of temperature.

The condition of the house has a direct influence on the comfort/indoor climate:
A less insulated house has:

- more fluctuation of temperature and relative humidity
- lower average temperatures

The condition of the house has an indirect influence: the user adjusts the comfort requirements

- lower temperatures
- fewer heated rooms in the house
- users tend to use an outdated heating system less, resulting in lower indoor temperatures

2.1.2. Energy use

The annual energy consumption of the twelve investigated dwellings is below the Flemish average. Possible explanations:

- 50% of the houses have a lower indoor temperatures than average
- 50% of the houses have an unheated night zone
- Efficient heating behaviour: up to 65% less consumption than predicted by the Flemish EPB software

which is the implementation of the European Energy Performance of Buildings Directive 2002/91/EC 100.

- Housing type: most of them are terraced houses, hence are relatively compact in comparison to Flemish averages.

By insulating these houses, large energy savings would be possible. If the entire building envelope of one of the examined houses would be insulated, there would be 58% gas savings. If on top of that, a new gas-condensing boiler with induced efficiency (97.7%) and photovoltaic solar panels (2.6 kWp) would be installed, there could be a saving of 76% on gas. Of course this is for one specific house: a single family terraced house with an extension, with a surface of 142 m², a protected volume of 435m³, a compactness of 2.14 (compact house) and an energy performance of E239. The 'E level' is a Flemish indicator for the building energy performance (Flemish EPB software) as a percentage result of the calculated annual primary energy consumption related to a characteristic annual primary energy consumption.

2.1.3. Scenario analysis

Figure 2 shows the Pareto front as result of a 'CashFlowSimulator'. It shows for four calculated dwellings the total actual costs according to the E-level for all possible combinations of building components and systems. Each point represents a combination of measures (building components and systems). The Pareto fronts are flat for the four dwellings. This shows that a better Energy performance (and a lower 'E level') can be achieved with limited added costs. The costs for installing a heath pump as the main heating system start to rise too much to remain financially optimal. As a conclusion, investing in energy saving renovation is most optimal starting from an E level of E20 and higher. Interestingly, the detached house (dwelling 3, blue) has the highest total actual costs. Dwelling 3 (blue) and 4 (yellow) have the highest costs because they invest more in works to improve the comfort level and less in energy saving works.

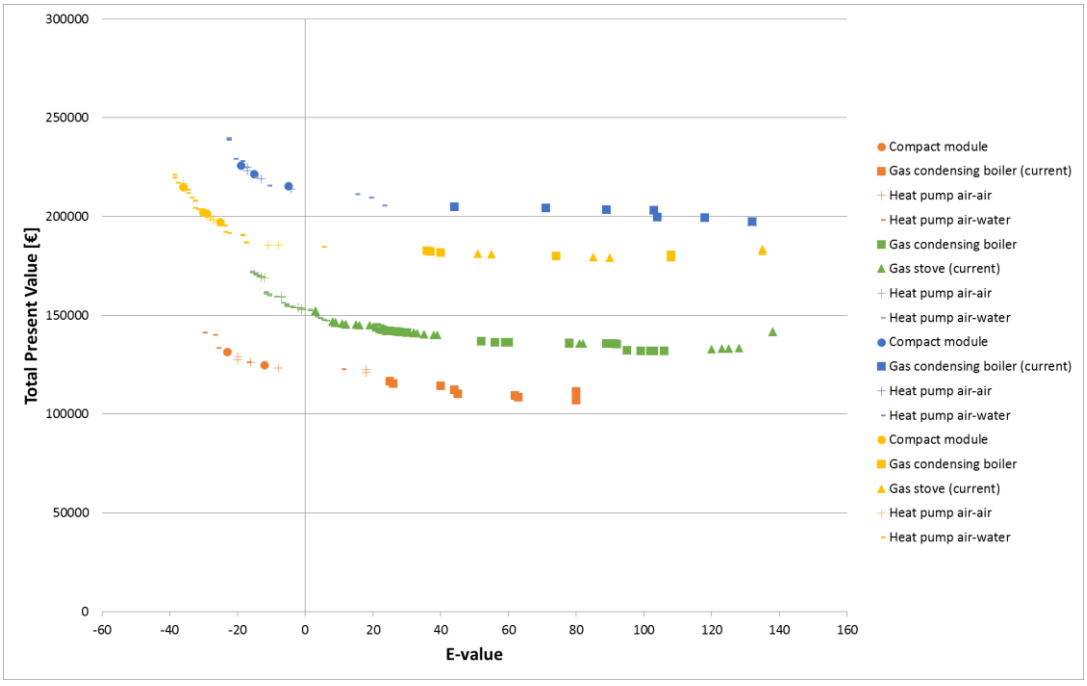

Figure 2: Results of the 'CashFlowSimulator': Total actual costs according to the E-level for the four dwellings (in four different colors).

An important annotation: it is a first assessment since the prices are based on the assumptions of the architect and not on actual prices of contractors.

2.2. *Catalogue of technical solutions*

Concerning the components (roofs, walls), most often (50%), the mineral variant is chosen. About 25% of the cases prefer the petrochemical variant and about 25% the bio-based variant. The choice has been made by the customer together with the architect, based on the information RenoseeC provided but also on personal preferences. Figure 3 shows that the environmental cost of the building components is very small in comparison to the energy gains through insulation.

On the graph, only a small difference between the seven left variants (with an U-value of 0,18 W/m²K) and the seven right variants (with an U-value of 0,11 W/m²K) is shown. So the more insulation, the better, but the first centimetres are the most important ones.

To estimate the energy savings of a renovation measure, the calculated energy consumption is compared to a reference baseline, which is in this case an uninsulated wall or roof. In most cases, the existing roof construction will be maintained. In the last solution in the graph below ('sarking - houtwol') the construction was removed and replaced.

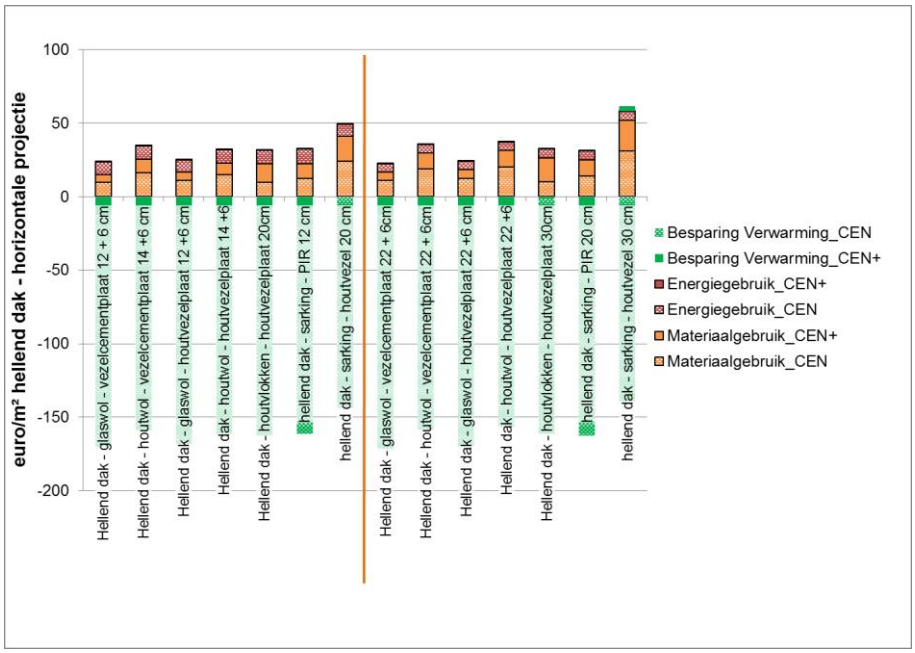

Figure 3: Aggregated environmental profiles (split up into CEN and CEN+) for several building element variants for 'pitched roofs' per environmental indicator, expressed in monetary units.

2.3. *Catalogue of financial solutions*

RenoseeC made an identification and selection of applicable financing solutions suitable for any type of target audience of the project, including low-income families. An important objective is to analyse the advantages of the collective over the individual renovation approach. For the selection of suitable financing models a difference is

made between the applicability in the experimental project and in the up-scaled project.

RenoseeC will mainly explore the principle of the revolving fund as used in the project 'Dampoort Knapt Op!'(DKO). This project offers ten low-income families the opportunity to renovate their house by providing independent advice and a fund for renovation. Each family gets a budget of €30.000 from the revolving fund set up by the Social Welfare Centre (OCMW), with the aim of improving the quality of life for homeowners and the energy performance of their buildings.

Participants were selected based on a clear framework of both social and building criteria. A smaller area in Dampoort in the city of Ghent - the same neighbourhood as RenoseeC - was selected.

To reduce the financial risk, the Social Welfare Centre (OCMW) takes a mortgage (usually in second grade) on the property. The amount is for pre-financing. Participants will have to refund the €30.000 when there is an alienation (sale, inheritance, etc.) of the house. The added value will be divided between the Social Welfare Centre (OCMW) and the participant (based on a value estimate before and after renovation). This is not a grant or loan; it is a system of subsidy retention. When the money is repaid, it can be re-used in the same way to the advantage of another low-income family

The financial model based on pre-funding and delayed repayment enables the inclusion of a target audience that would otherwise not have the possibility to renovate their home.

In another project in Flanders, "Limburgse Renovatielening/Duwolim", there is a partnership between the province Limburg, and a private bank. The bank 'Triodos' is financing the loans, in total €8 million, the province is financing the revolving fund, which is used for the operating costs for counselling. However, revolving funds also contain significant financial risks, e.g. regarding the refunding at the moment of alienation [7].

The instrument Energy Performance Contracting - a loan that is repaid by the expected energy savings – is successful for schools and commercial buildings, but not for private houses. They often pose a problem by variable occupant behaviour. For large apartment blocks (from 50 units) ESCOs are also feasible, but a device to measure the energy consumption appears to be too expensive for single-family houses.

For small refurbishments (e.g. painting, explanation of electricity, etc.) and preparation of renovations (e.g. attic clean up, demolition, etc.), not for structural or energy saving works, a local exchange trading system (abbreviated to LETS or LETSystem) could be interesting to explore. LETS is a locally initiated, democratically organised, not-for-profit community enterprise that provides a community information service and records transactions of members exchanging goods and services by using the currency of locally created LETS Credits [6].

3. Discussion

RenoseeC aims to roll out a business model for the collective, sustainable and affordable renovation of private single-family homes based on the results of the living lab that is ongoing in Ghent. During the second part of the four years VLAIO-project, it's the aim to renovate twenty houses, to perform a second energy-monitoring after renovation, to make a user friendly script describing in detail every single step in the process, going from the use of the catalogue of solutions to the realisation of the collective and phased renovation, and to carry out the social impact assessment. At the same time, the business model will be elaborated in a step-by-step approach with all the involved partners. It will be based on the five specific challenges: (i) the optimisation of the collective approach, (ii) the cooperation of the supply side, (iii) the strengthening of the demand side, (iv) the reach of vulnerable groups and (v) the scalability and reproducibility.

Below, lessons learned until now concerning the five challenges are listed. Obviously these lessons have to be discussed with all partners, developed and translated into the business model.

(i) Optimisation of the collective approach

Regarding the target in terms of number of participants, the collective approach seems to be successful. Besides, the collectivity is displayed by the concentration in one neighbourhood, working with standardised solutions (catalogue), working with one contractor and through a mandate agreement (one-stop-shop).

The limited range of standardised solutions (catalogue) also facilitates people's choices. This is one of the advantages of the catalogue of technical solutions that is associated with the collective approach and the unburdening. One of the aims is to have a limited number of solutions, increasing both technical quality as well as affordability. In any case the economies of scale will make the renovation process more efficient, both for the architect and the contractor. At the end of the project it will have to be evaluated whether the approach of the collective sequential execution is successful or not.

Up to now, however, this collective approach can only be successful if this goes along with the cooperation of the supply side (producers and contractors) and the strengthening of the demand side (house owners, see below).

(ii) The cooperation of the supply-side

Several partners on the supply-side have a crucial role in the project. They can be divided into two types: social and technical partners. Cooperation between these two types of partners is crucial, especially regarding convincing potential participants of the credibility of the project.

Social partners that are already active within the neighbourhood have a key role in the recruitment of participants. Not only do they have a clear picture of various needs amongst the different target groups, they also are experienced in how to approach them. Additionally, the local government can provide extra support and stimulation, e.g. through development of new, or promotion of already existing subsidy schemes.

On the other hand, there are also the technical partners like the architect, the researcher, the manufacturers and the contractors.

The architect must not only have experience with energy efficient renovations, but also have social skills; for example it is important to give sufficient explanation, and to talk about opportunities (comfort…) and not only about problems (energy performance). Besides, an architect has to be as independent as possible. Within the project this is reinforced by the researchers of the University involved, assisting by making calculations as a scientific background (LCA analysis, scenario analysis) or by providing tools with a scientific background. Whether tools are sufficient or not has to be investigated in the next year before the upscaling, so the business model can be adapted if needed.

Cooperating with the building products manufacturers provides different opportunities: architects, contractors and customers can get all necessary information about the products and best practices, and innovating products can be used in the renovation. In order to prevent conflicts of interest from arising, a wide range of manufacturers were involved in the project, providing equal solutions (e.g. plastics, mineral and bio-based). Judging from provisional feedback from the participants, the involvement of such a wide range of stakeholders results in strengthened credibility of the project.

(iii) The strengthening of the demand side

A lot of people have neither the knowledge nor the will to start major home renovation; they want to avoid the administrative and practical hassle, the difficult search for contractors, the time investment in research work, contracting, monitoring, etc. Lampiris-Isol, an initiative that offers the placement of thermal insulation, with an option for a personal loan, encountered that not the financial incentives but the unburdening could be a convincing factor to stimulate people to start a renovation [20]. Up to now, that's the same conclusion of RenoseeC. An

important reason why people enrol in the project is because of the unburdening elements (practical, financial and technical).

Besides, people need a serious, reliable and independent partner. Therefore it is good to provide people confident and independent advice, take people seriously and invest in communication. In the beginning of the project, when they enrol, they also need a structure/roadmap for the whole process; people should have a clear view of the timing and the costs associated with each stage.

A major challenge lies in winning confidence and convincing potential participants. The support of the city and locally based organisations with sufficient individual support plays a crucial role.

Another challenge is to find the right speed. Some people need more time to make decisions; "It's going fast", they tell us. Others want to move forward… Because of this discord, two phases of execution were put up, the first starting in autumn 2016, the second one in spring 2017.

(iv) The attainment of vulnerable groups

Only limited publicity (flyers, posters) was necessary to announce the project to the middle class in the area, but to reach and convince the vulnerable target audience was more difficult and required more time and energy. Distribution of flyers and posters was clearly not sufficient. A proactive approach was needed. Therefore, the social partner organisation additionally invested in the recruitment of vulnerable groups, e.g. through involving key figures from the neighbourhood (from schools, Turkish woman organisations, etc.).

With the recruitment phase finished, it can be concluded that it is possible to reach the vulnerable groups, but a specific approach is needed to convince them to join the project. Not only do they need a suitable financial scheme (see chapter 3.5) allowing them to improve their housing quality without creating immediate debt, they also require a much more intensive counselling process in order to gain their trust and point out priority renovation measures.

(iv) The scalability and reproducibility

The aim is to upscale the RenoseeC pilot project without subsidies. Therefore, the business model is being developed, with all crucial stakeholders.

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